UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT
UNCTAD

No.50
OCTOBER 2016

POLICY BRIEF

ROBOTS AND INDUSTRIALIZATION IN DEVELOPING COUNTRIES

Industrialization has historically been synonymous with development, while deindustrialization is a well-established trend in mature developed economies as they move towards services-based economies. Yet recent trends show that many developing countries – especially in Africa and Latin America – have witnessed their shares of manufacturing employment and output shrinking long before they have attained income levels comparable to those in the developed world. Such premature deindustrialization began during the adjustment programmes in the 1980s and 1990s, yet has continued, as commodity booms and speculative financial inflows have led to currency appreciation and a loss of manufacturing competitiveness, compounded by the rise of China's manufacturing exports. The current question is therefore: now that the commodity bonanza is over, capital flows are reversing and China is turning towards a more balanced growth path driven more by domestic demand than exports, how can Africa and Latin America reignite industrialization? Whatever the chosen strategy, it will have to account for the rapidly increasing spread of new automation technologies and artificial intelligence in the form of robots.

Key points

- Increased use of robots in developed countries erodes traditional labour-cost advantage of developing countries.
- Labour-intensive manufacturing in large developing countries with domestic production linkages is unlikely to be reshored to developed countries.
- Whatever the impacts, outcomes will be shaped by policies.
- Developing countries need to redesign education policies and embrace the digital revolution – this approach should be combined with supportive macroeconomic, industrial and social policies.

UNITED NATIONS
UNCTAD

Much of the discussion on the economic effects of the use of robots has concentrated on the effects in developed countries. Optimists state that any adverse effects will be short-lived and that robots may help overcome slowdowns in productivity growth and increase worker income and well-being. Pessimists point to the rapid pace and increasing scope of new technological breakthroughs, and state that, due to their microprocessors, robots may require only a small number of better-skilled workers for their operation, rather than the requirement for large numbers of low-skilled workers that complemented earlier technological breakthroughs such as the steam engine. The result may be enduring adverse employment and distributional effects. Both narratives are coherent and may actually occur simultaneously, with benefits accruing in productivity growth and for better-skilled workers and the owners of robots, while low-skilled workers risk being impoverished.

Potential North–South industrialization effects of the use of robots

The increased use of robots in developed countries risks eroding the traditional labour-cost advantage of developing countries. If robots are considered a form of capital that is a close substitute for low-skilled workers, then their growing use reduces the share of human labour in total production costs. Adverse effects for developing countries may be significant. According to some estimates, for developing countries as a group, the "share of occupations that could experience significant automation is actually higher in developing countries than in more advanced ones, where many of these jobs have already disappeared", and this concerns about two thirds of all jobs.[1]

Reshoring economic activities to developed countries is one mechanism that could lead to shrinking output and employment in the manufacturing sector of developing countries. Developed countries may aim to reshore in

1 World Bank, 2016, *World Development Report 2016: Digital Dividends*, Washington, D.C. These estimates are aggregate numbers that combine all economic sectors (namely, agriculture, industry and services).

order to regain international competitiveness in manufacturing and stem the decline in manufacturing employment and the polarization of income that is to the detriment of middle-class workers. Reshoring could turn global value chains on their head, and lead to their decline as a potential industrialization strategy for developing countries.

Yet there is mixed evidence for the importance of reshoring and its underlying motivations. Some reshoring has occurred, especially in activities where automation and other technological advancements are important for production processes. However, economy-wide effects are minor. The slow pace of reshoring may partly be explained by tepid investment and sluggish aggregate demand more generally. In addition, developed countries now lack the supplier networks that some developing countries have built to complement assembly activities. Finally, offshoring continues to take place, and while labour-cost differentials remain a factor in the decision of firms on where to locate production, especially of goods with a high labour content, demand factors such as the size and growth of local markets are becoming increasingly important determinants. This means that the production of labour-intensive manufactures destined for rapidly growing markets in large developing countries that have domestic production linkages is unlikely to be reshored. The evidence also shows, however, that where reshoring to developed countries has occurred, it has fallen short of expected re-industrialization effects. Reshoring has mostly been accompanied by capital investment, such as in robots, with the minimal job creation that has occurred being concentrated in high-skilled activities, and has thereby sharpened income polarization.[2]

Potential impacts of the use of robots on industrial development in developing countries

How might the use of robots affect industrialization prospects within the group of developing countries?

Would the deployment of robots in Africa and Latin America help economies in these regions benefit from potential export opportunities in manufacturing activities vacated by China as it shifts towards a new growth model?

To the extent that relative factor endowments determine the international division of labour, the use of robots could alter the location of manufacturing of particular sorts of goods and services by altering their relative factor intensities. Assuming that low-skilled human labour and the use of robots are close substitutes and that robots controlled by high-skilled workers could perform, for example, clothing production and electronics assembly more efficiently than low-skilled workers, then these activities become relatively more skill-intensive. Deploying more robots than others would allow countries to increase their relative supplies of effective low-skilled labour (including both low-skilled human workers and robots). Doing so would allow countries with a low ratio of low-skilled to high-skilled workers to reduce their labour-cost disadvantage and make labour-intensive manufacturing more competitive. Accordingly, such activities could shift from countries with a relatively high ratio of low-skilled to high-skilled workers, such as China, to countries with a relatively low ratio, such as in parts of Africa and Latin America. The result would be a shift in the latter countries' sectoral structure of output and export towards a larger share of manufactures.

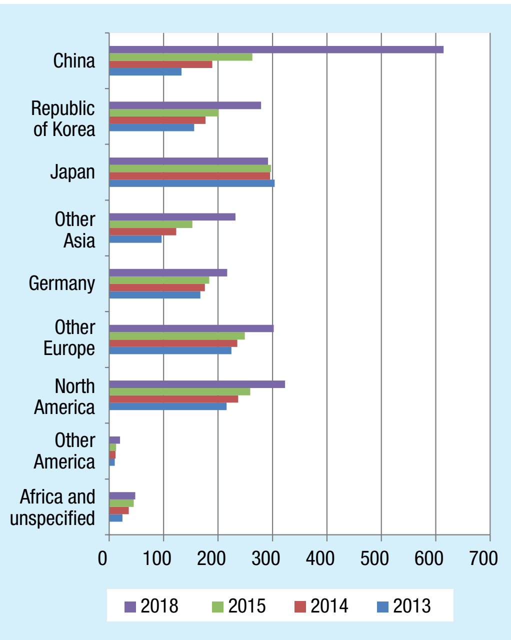
It is not clear whether such shifts in activity in entire sectors may be expected to occur. Drawing on insights from more recent trade theory, which stresses the importance of firms and their heterogeneity in terms of productivity even within economic sectors, gives different results. Productivity differences may arise because some firms choose to produce in more technology-intensive ways, for example by deploying more robots than other firms. This may make them sufficiently competitive to begin exporting. Such effects may be reinforced by combining robotization with other new automation technologies, such as three-dimensional printing. The latter lowers the costs of prototyping and small-volume production, and could facilitate the initiation of manufacturing of new products, whose large-scale production could become economically feasible through the deployment of robots. Imitation by other manufacturers ready to undertake fixed-cost investments in robots and other automation technologies could boost a country's industrialization level generally and ignite a gradual increase in the share of manufacturing in its output and export structure. Another effect of deploying robots may be that this type of technology upgrading helps firms at initially lower productivity levels avoid being driven out of the market through import competition, and this could help stem deindustrialization. Intra-industry reallocations of market shares

2 The discussion in this paragraph partly draws on M Cohen, S Cui, R Ernst, A Huchzermeier, P Kouvelis, H Lee, H Matsuo, M Steuber and A Tsayet, 2016, Off-, on- or reshoring: Benchmarking of current manufacturing location decisions, The Global Supply Chain Benchmark Consortium, available at http://pulsar.wharton.upenn.edu/fd/resources/20160321GSCBSFinalReport.pdf (accessed 19 October 2016); and K De Backer, C Menon, I Desnoyers-James and L Moussiegt, 2016, Reshoring: Myth or reality? Science, Technology and Industry Policy Papers No. 27, Organization for Economic Cooperation and Development, available at http://www.oecd-ilibrary.org/science-and-technology/reshoring-myth-or-reality_5jm56frbm38s-en (accessed 19 October 2016).

and productive resources between firms are likely to be much more pronounced than sector-wide inter-industry reallocations that would require factor-intensity changes of a much wider range.

A country wishing to benefit from such effects must deploy more robots than others. According to data from the International Federation of Robotics, recent deployments of industrial robots[3] in developing countries have been concentrated in China, and the country is expected to maintain its front-runner status (figure 1). In response to a shrinking working-age population and rising labour costs, which have eroded the country's cheap-labour advantage, China has embarked on a government-backed robot-driven industrial strategy entitled "Made in China 2025". Each year since 2013, China has bought more industrial robots than any other country and, by the end of 2016, is likely to overtake Japan as the world's biggest operator of industrial robots. While its robot density – robots per industrial workers – continues to fall short of that of Germany, Japan and the Republic of Korea, the rapid pace of robot deployment is likely to significantly reduce the erosion of China's comparative advantage in labour-intensive manufacturing.[4]

Figure 1. Estimated year-end operational stock of industrial robots, selected countries and regions, 2013–2018 (Thousands of units)

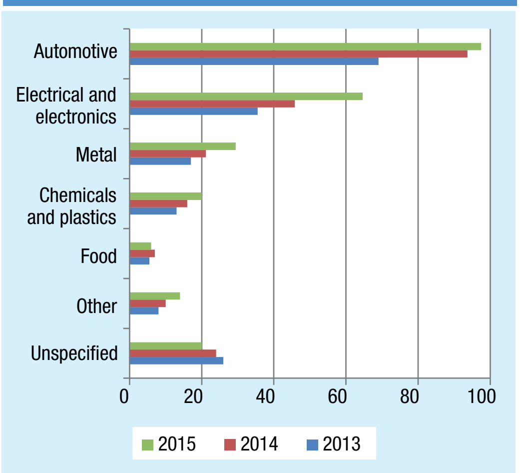


The data also show, however, that industrial robots have primarily been deployed in the automotive, electrical and electronics industries (figure 2). This means that in developing countries – such as Mexico and many countries in Asia – those engaged in export activities in these two sectors are the most exposed to reshoring. By contrast, in many labour-intensive industries, such as garment-making, widespread automation is not yet suitable. While robots have become cheaper, some developing countries continue to have a large pool of cheap labour. Thus, for those countries whose major challenge is to create jobs for a large number of low-skilled entrants to the labour force – such as in many parts of Africa – deploying robots under current cost structures may drive production costs up, rather than down.

Looking beyond output effects, the distributional impacts of robots on employment and income in developing countries will, at least initially, tend to move against inclusiveness, as in developed countries. Job creation will tend to be concentrated in high-skill activities with comparatively fewer benefits for low-skilled and medium-skilled workers.

The fiscal implications of robot deployment remain an open question. Clearly, without the introduction of a major tax on robots as capital equipment, robot-based manufacturing cannot boost the fiscal revenues needed to finance both social transfers, to support workers made redundant by robots, and minimum wages, to stem a decline in the living standards of low-skilled and medium-skilled workers.

Figure 2. Estimated worldwide year-end annual supply of industrial robots, by main industry, 2013–2015 (Thousands of units)



Source: UNCTAD secretariat calculations, based on International Federation of Robotics, 2015, World Robotics 2015: Industrial Robots, available at http://www.ifr.org/industrial-robots/statistics/ (accessed 19 October 2016).

3 According to the International Organization for Standardization series of standards on robots and robotic devices – vocabulary (8373), an industrial robot is an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.

4 China is also evolving as a major producer of industrial robots, given that its global rivals face higher costs and are less able to understand the needs of Chinese customers. Building on these advantages, the Government of China recently released a guideline envisaging a tripling of China's annual production of industrial robots by 2020 (see http://www.china.org.cn/china/Off_the_Wire/2016-04/27/content_38337248.htm).

Policy implications

Much of the debate on the economic impacts of the use of robots remains speculative, and disruptive technologies always bring a mix of benefits and risks. Whatever the impacts, final outcomes will be shaped by policies. A comprehensive approach aimed at maximizing the benefits of the use of robots for industrialization in developing countries includes consideration of the following elements:

- Any industrialization strategy in developing countries will benefit from stable but expansionary global economic conditions driven by sustained productive investment and supported by broad-based global income growth. A policy shift in developed countries towards combining expansionary monetary and credit policies with a proactive fiscal stance and a sustained increase in the share of wages in national income could ignite a sustained expansion of consumption and productive investment, based on the favourable income expectations of consumers and positive demand expectations of entrepreneurs. This could turn around slowdowns in productivity and global demand growth, in the process boosting the opportunities of developing countries for industrialization through manufactured exports.
- To fully benefit from an expanding global economy, developing countries should embrace the digital revolution. This requires redesigning education systems to create the managerial and labour skills needed to operate new technologies and widely diffuse the benefits of their use, as well as to complement them, as the combination of skilled labour and automation may be superior to either on its own. It also requires establishing Internet links between massive data storage and the computing devices that power the increased use of robots, and developing the associated regulatory frameworks. In addition to creating benefits from automation, digitization could open up new development opportunities. Combining robots and three-dimensional printing could create new possibilities for small enterprises to overcome size limits in production and to conduct business – both cross-border and national – on a much larger scale.
- Robots are not yet suitable for a range of labour-intensive industries, leaving the door open for developing countries to enter industrialization processes along traditional lines. Garment-making has been a stepping stone in many cases of industrialization, supported by preferential market access conditions. An expansion of the trade preference programmes of developed countries – such as by providing comprehensive coverage of duty-free and quota-free market access to labour-intensive exports from developing countries, combined with rules of origin that are simple to use and flexible in meeting producer needs – could prove crucial, especially for least developed countries, in order to benefit from China's shift towards a new growth model and to support initial stages of industrialization in these countries. Moreover, enhanced regional trade integration among developing countries could help them attain a market size that is sufficiently large for even affiliates of transnational corporations to forego reshoring and maintain production in these countries.
- Building a dense network of intra-sectoral and cross-sectoral linkages and complementarities could further stem the risk of reshoring, even as the cost of owning and operating robotics systems further declines and the scope of economically feasible automation gradually broadens, to also affect traditional, labour-intensive sectors such as garment-making. This requires enhanced public investment in logistics and telecommunications infrastructure and power and water utilities, as well as in a supportive technological environment and innovation system. Also needed are reliable supply networks that provide production inputs of the right quality at the right place and at the right time.

All of the above policies must be undertaken within a whole-of-government approach that also guarantees macroeconomic stability and the availability of investment finance, adopts supportive industrial policy, pursues an industrialization strategy aimed at the deployment of automation technologies that boosts the upgrading of labour skills and the international competitiveness of firms, and that expands social safety nets and redistributive policies to address the adverse effects on employment and inclusiveness that will undoubtedly occur, at least in the short term.

Contact

Richard Kozul-Wright,
Director,
Division on Globalization and Development Strategies
Tel. +41 22 917 5615
richard.kozul-wright@unctad.org

Press Office
+41 22 917 58 28
unctadpress@unctad.org
www.unctad.org

UNITED NATIONS
UNCTAD

UNCTAD/PRESS/PB/2016/6 (No. 50)